Synthesis Characterization and Applications of Supramolecular Metal Organic Crystals and Hydrogels Materials

SYNOPSIS

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Supramolecular Chemistry,[1] is chemistry beyond molecule,[1,2] focuses the chemical systems made up of molecular subunits assembled by non-covalent types of interactions including hydrogen bonding interactions, π···π interactions, lone pair···π interactions, van der Waals forces, different hydrophobic and electrostatic interactions, etc.[3,4] Traditionally, molecular chemistry deals with the construction of molecules and generally, pacts with bond-breaking and bond formation chemistry, while the supramolecular chemistry related with the construction of organized molecular arrays manifested by the interplay of versatile non-covalent types of interactions.[1,2] Supramolecular chemistry includes host-guest chemistry, self-assembly, and molecular recognition processes.[1-4]

The functionality is a key research objective towards scientists. The generation of advanced functional materials by utilizing novel organic and inorganic chemical constituents is new avenue for us. In that respect supramolecular chemistry plays an important role for the development of novel functional materials including pure organic and organic-inorganic hybrid materials.[5,6] The preparation of water soluble metallo and organo-supramolecular networks including crystalline solids and soft gel materials in water medium is a big challenge for chemists as water is a bio-solvent.[5,6] Hence, the main challenge of this project is to generate water soluble organic and metal-organic soft and crystalline supramolecular functional materials.[5-7] I have also found the sensing nature of some extremely toxic metal ions and anions in water medium and in biological system by exploiting these water soluble supramolecular networks.[5,6] We have aim to inculcate the bio-relevance of these newly synthesised materials and simultaneously we try to develop biologically benign biochemical stuffs.[6]

I have attempt to synthesize some selective water soluble metallo-supramolecular architectures by several metal ions including Cu^{2+}, Mn^{2+}, Co^{2+}, Cd^{2+}, Ni^{2+} Zn^{2+}, Mg^{2+} and few specific organo-supramolecular networks involving N-heterocycles consisting of aromatic oligo-pyridines and acyclic moieties. The primary and secondary ligands have been exploited for the Supramolecular metal complex formation of those above said metal ions which finally leads to intriguing metallo-supramolecular architectures. The principle goal of the investigation is to get the synthetic route and simultaneously

achieving novel functionalities of different crystalline metallo and organo-supramolecules. These all experimentally characterized by Transmission electron microscope (TEM), Scanning electron microscope (SEM), Atomic force microscope (AFM), IR, TG, CHNS analysis, X-RAY Powder Diffraction(XRPD), Single crystal X-ray diffraction study, ESI-MS, UV-VIS and fluorescence spectra study, magnetic study, porosity study, etc.

I have synthesized a novel Molybdenum dichalcogenides based hydrogel. From the microstructural analysis (i.e SEM, FESEM, TEM and AFM) we confirmed that the selenium has a tremendous role to alteration the morphological patterns of hydrogel. Whereas the Sulfur make the rheological patterns of basic hydrogel as more tough materials. From $MoSe_2$ based hydrogel we have successively synthesized luminescent 'nano-rod', which are tremendously effective to take part in 'Hydrogen Evolution Reaction' by splitting water from Cyclic Voltametry (CV) analysis.

I have also synthesized some transition metal ion based hydrogel and metallogel by using low molecular weight ligands (LMWGs). Some of them are very interesting as they can absorb carbon dioxide (CO_2) direct from the air and it may convert the absorbed CO_2 to methane (CH_4) with some presence bacterial effect. I have synthesized transition metals based magnetic metallohydrogels which are behave like electronic devices such as Schottky barrier diode. Such metallohydrogels advocates the future possibility of achieving the gel-material based spintronics devices applicable in technology. All the gels are characterized by Rheology, FTIR, TG, FESEM, SEM, PXRD, Raman Spectroscopy and BET. I am also trying to establish some energy harvesting materials to help our society directly.

Next, I have planned to generate actual energy harvesting/evolution materials to make our nation benefit directly.

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